

What is claimed is:

1. A method of manufacturing a system-on-chip semiconductor device, including a CMOS logic circuit portion and a DRAM portion, comprising the steps of:

forming at least a first transistor on a substrate at said CMOS logic circuit portion;

forming at least a second transistor on said substrate at said DRAM portion;

forming an interlayer film on said substrate at said CMOS logic circuit portion and on said substrate at said DRAM portion, covering said at least a first transistor and said at least a second transistor;

forming a groove in said interlayer film by removing a portion of said interlayer film at said DRAM portion;

forming a first polysilicon film on an upper surface of said interlayer film at said CMOS logic circuit portion and at said DRAM portion, and a second polysilicon film on an inner wall of said groove at said DRAM portion,

forming a first HSG on a surface of said first polysilicon film and a second HSG on a surface of said second polysilicon film; and

removing said first HSG and said first polysilicon film.

2. The method of manufacturing a system-on-chip semiconductor device as claimed in claim 1,

wherein said step of forming said at least a first transistor includes a step of forming a first gate insulating layer, and

wherein said step of forming said at least a second transistor includes a step of forming a second gate insulating layer,

wherein said first gate insulating layer is thinner than said second gate insulating layer.

3. The method of manufacturing a system-on-chip semiconductor device as claimed in claim 2,

wherein said at least a second transistor comprises a peripheral circuit transistor and a switching transistor, and

wherein said peripheral circuit transistor and said switching transistor have similar structures.

4. The method of manufacturing a system-on-chip semiconductor device as claimed in claim 3, wherein said step of forming an interlayer film comprises steps of:

forming a first interlayer film comprising a silicon oxide layer; and thereafter

forming a second interlayer film comprising a BPSG film.

5. The method of manufacturing a system-on-chip semiconductor device as claimed in claim 4, further comprising steps of:

forming an opening in said first interlayer film over a diffusion region of said switching transistor; and

forming a capacitor electrode in said opening in said first interlayer film,

wherein said capacitor electrode is connected to said diffusion region of said switching transistor.

6. The method of manufacturing a system-on-chip semiconductor device as claimed in claim 5, wherein said groove is formed in said second interlayer film, and said second polysilicon is connected to said capacitor electrode.

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7. The method of manufacturing a system-on-chip semiconductor device as claimed in claim 6, further comprising steps of:

forming a first photoresist layer on said first HSG and a second resist layer on said second HSG; and

5 removing said first photoresist layer to expose said first HSG.

8. The method of manufacturing a system-on-chip semiconductor device as claimed in claim 7, further comprising steps of:

forming a capacitor film on said first HSG after said step of removing said first photoresist layer; and

forming an upper electrode on said capacitor film.

9. The method of manufacturing a system-on-chip semiconductor device as claimed in claim 8, wherein said capacitor film comprises a Ta_2O_5 film; and

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further comprising a step of forming a TiN film on said Ta_2O_5 before said step of forming said upper electrode.

10. The method of manufacturing a system-on-chip semiconductor device as claimed in claim 2, wherein said step of forming said at least a first transistor further comprises steps of:

forming a first gate electrode comprising polysilicon; and
5 doping the polysilicon of the first gate electrode with boron,
wherein said at least a first transistor comprises a p-channel transistor having said
first gate.

11. The method of manufacturing a system-on-chip semiconductor device as
claimed in claim 10, wherein said step of forming at least a first transistor further comprises
steps of:

forming a second gate electrode comprising polysilicon;
doping the polysilicon of the second gate electrode with phosphorous;
wherein said at least a first transistor comprises a n-channel transistor having said
second gate.

12. The method of manufacturing a system-on-chip semiconductor device as
claimed in claim 2, wherein said step of forming an interlayer film comprises a step of
forming a BPSG film.

13. The method of manufacturing a system-on-chip semiconductor device as
claimed in claim 12, wherein said step of forming an interlayer film further comprises a step
of forming a silicon oxide layer prior to forming said BPSG film, wherein said BPSG film is
formed on said silicon oxide film.

14. The method of manufacturing a system-on-chip semiconductor device as
claimed in claim 2, wherein said DRAM portion comprises a memory cell portion and a

peripheral circuit portion, and a surface area of said memory cell portion is 10 to 25% of a sum of surface areas of said DRAM portion and said CMOS logic circuit portion.

15. The method of manufacturing a system-on-chip semiconductor device as claimed in claim 14, wherein said surface area of said memory cell portion is 50 to 60% of the surface area of said DRAM portion.

16. A method of manufacturing a system-on-chip semiconductor device including a CMOS logic circuit portion and a DRAM portion, said DRAM portion comprising a cylinder type capacitor, the method comprising the steps of:

forming a first transistor on a substrate at said CMOS logic circuit portion;

forming a second transistor on said substrate at said DRAM portion;

forming an interlayer film on said substrate at said CMOS logic circuit portion and on said substrate at said DRAM portion, covering said first transistor and said second transistor;

forming a groove in said interlayer film by removing a portion of said interlayer film at said DRAM portion;

forming a polysilicon film on a said interlayer film at said CMOS logic circuit portion and at said DRAM portion, and on a inner wall of said groove at said DRAM portion,

forming a HSG on a surface of said polysilicon film; and

removing said HSG and said polysilicon film from an upper surface of said interlayer film, retaining at least a portion of said HSG in said groove and at least a portion said polysilicon in said groove.

17. The method of manufacturing a system-on-chip semiconductor device as claimed in claim 16,

wherein said step of forming said at least a first transistor includes a step of forming a first gate insulating layer, and

wherein said step of forming said at least a second transistor includes a step of forming a second gate insulating layer,

wherein said first gate insulating layer is thinner than said second gate insulating layer.

18. The method of manufacturing a system-on-chip semiconductor device as claimed in claim 17, wherein said step of forming said first transistor further comprises steps of:

forming a first gate electrode comprising polysilicon; and

doping the polysilicon of the first gate electrode with boron,

wherein said first transistor comprises a p-channel transistor having said first gate.

19. The method of manufacturing a system-on-chip semiconductor device as claimed in claim 17, wherein said step of forming an interlayer film comprises a step of forming a BPSG film.